ZOOLOGICAL SURVEY OF INDIA AND ITS IMPACT ON THE STUDY OF FIELD ZOOLOGY IN INDIA

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The Zoological Survey of India came into existence in 1916. In the first half of the 20th century, that is, in British India, its surveys and expeditions were not limited to the Indian subcontinent, but extended as far as Iran, Ethiopia, Palestine, Tibet, Thailand, China and Japan.

In the marine field, as an offshoot of the earlier Marine Survey of India, the *R.I.M.S.S. Investigator* carried out deep-sea trawling in Indian territorial waters.

There was a lull, forced by financial constraints, between 1931 and 1946. After India's independence in 1947, surveys and collections were limited to India, but were carried out on a more extensive scale. Exceptions were the brief forays, where the Survey's scientists joined forces with other international institutions, such as the U.K. *Daily Mail* Himalayan Expedition in 1954, Cho Oyu Expedition to Nepal (1958), Harvard Yale Expedition to Sikkim in 1958 (Sikkim was then not part of India), Indo-German Expedition (1955-58), Indo-Swiss Expedition, Ross Expedition (1961-62) and Royal Ontario Museum Expedition.

In the sea, ZSI scientists participated in the International Indian Ocean Expedition from 1962-64, with the Defence Research and Development Organisation and on board *I.N.S. Darshak* (1973-74).

With the creation of several regional and field stations in the third Five Year Plan (1961-66) and a field station at Kakdweep in 1979, specialised ecological studies can now be carried out for desert, alpine, grassland, forest, marine and coral reef habitats. With current emphasis on the environment and wildlife conservation, ZSI has now also branched out into these fields, apart from biodiversity conservation and bioprospecting, environmental impact assay, animals in relation to tribals and joint collaboration for agriculture, forestry, fisheries and public health.

INTRODUCTION

The importance of field studies in any exploratory and bio-ecological research needs no mention. In order to understand the occurrence, abundance and distribution of species in space and time, its interrelationship with the biotic and abiotic factors of the environment and its mode of life, particularly feeding and reproduction, extensive and intensive field studies are essential prerequisites. Today, the Zoological Survey of India is the only organisation in the country with a massive set-up for survey and exploration of faunal diversity in different eco-zones in all parts of the country. It has its field establishments right from the high altitudes of the Himalaya to the Indian Ocean, from the deserts of Rajasthan to the tropical rainforests of the Northeast. There is hardly any ecosystem in the country, where the scientists of the Zoological Survey of India have not carried out their field studies. This is clearly evident from the huge National Zoological Collection maintained at Headquarters and in the sixteen Regional Stations located throughout the country.

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HISTORICAL RÉSUMÉ OF FIELD STUDIES

Pre-independence

The Zoological Survey of India (ZSI) was established in 1916 as an offshoot of the Indian Museum, Zoology Section, primarily to promote survey, exploration and research leading to the advancement of our knowledge of various aspects of the exceptionally rich animal life of the erstwhile British Indian Empire. Initially, the ZSI acquired more than a century old zoological collections from the former Museum of the Asiatic Society of Bengal and the Zoology Section of the Indian

Museum. The main task of the Indian Museum (1875-1916) and the Asiatic Society of Bengal (1814-1875) was to identify and exhibit the zoological collections deposited by explorers and naturalists of British India when organised field studies for fauna were very limited. However, it was soon realised that the job of the Survey was not purely museum taxonomy, and without detailed field studies, any conclusion regarding the habit and habitat of a species would not be very meaningful.

Going back to the contribution of early zoological explorers, the foremost name is that of Dr. John Anderson who made two expeditions into Yunnan (China) in 1868 and 1875. Thereafter, various other collections came from regions as far apart as Ethiopia, Iran, Tibet, and from different parts of India and Burma. Even today, the Survey holds the collections and field notes made by naturalists during the Persian Boundary Commission (1870-72), the Second Yarkand Mission (1873-74) and the Dafla Expedition (1874-75).

The next phase of field studies was undertaken when the British Government formed the Marine Survey of India for investigation of deep-sea fauna. This task was assigned to the Surgeon Naturalist attached to the Marine Survey of India. The deep-sea explorations started in 1822 when the *Royal Indian Marine Survey Ship Investigator* was launched. It was under the able and dynamic leadership of distinguished scientists like Lt Col. Alfred William Alcock, the Surgeon Naturalist, who conducted extensive and intensive deep-sea field studies. The material brought back by the *Investigator* provided, for the first time, a foundation for the systematic study of the deep sea and its inhabitants.

A number of expeditions and field zoological studies were made in various parts of India and even beyond its frontiers. Mention may be made of the expeditions by T.N. Annandale to the Lake of Galilee, Tiberias, Palestine; to the Tale Sap in Thailand; and to Lake Biwa in Japan. During this period, extensive field studies were carried out and valuable collections of both land and freshwater fauna were made during several political and military expeditions.

Exploratory field studies gained considerable importance after the official creation of the Zoological Survey of India, as an independent organisation. The post of Surgeon Naturalist, Marine Survey of India, was transferred to the ZSI in 1920. Major R.B. Seymour Sewell, a Surgeon Naturalist, also became a member of the Survey with a rank of Superintendent. Fieldwork was then considered one of the most important duties of the Survey and thus detailed programmes of work were formulated which were carried out over the years under the leadership of Dr. Annandale, including a pioneering field survey of Chilka Lake.

It was a landmark in the field studies of the Zoological Survey of India, when the ruling British Government expressed its concern regarding the spread of Schistosomiasis, and asked the Survey to undertake detailed studies on freshwater molluscs with a view to investigate the possibility of their acting as vectors of human Schistosomiasis. The other important field studies during the period were on the fauna of Siju Cave.

The seeds of environmental research were already being sown at the Zoological Survey of India, even during those early years. Two areas that were undergoing considerable change as a result of certain engineering schemes were investigated. The first of these was Manchar Lake in Sind (now in Pakistan) after the erection of the Sukkur barrage on River Indus, and the second was Vishakapatnam, where changes were likely to occur as a result of the construction of a harbour in this area.

The period between 1931 and 1946 was difficult for the ZSI because of a massive financial crunch; long distance surveys and field studies suffered greatly. However, even during this lean period, extensive ecological and taxonomic surveys were carried out in the vast wetland areas

of the erstwhile north and south Salt lakes of the Sunderbans. Regular field trips were made and extensive studies were carried out on the fauna in that wilderness.

Post independence

The early post-independence period was marked by the notable contribution of the Survey under the dynamic leadership of Dr. Sunder Lal Hora. During this period, important field studies were conducted on the aquatic and terrestrial fauna of the areas which were to be affected by the proposed Rihund Dam and Damodar Valley Projects. As a result, special surveys of the dam sites were initiated, to find a solution to the problems regarding fish passes and fish ladders, in collaboration with the Central Board of Irrigation and Power.

During the first Five Year Plan, the services of the Survey were utilised by numerous institutions and workers interested in the application of zoological knowledge to practical problems. Preliminary assessment of the wildlife resources of the country was also carried out. Field studies were conducted in (i) Pachmarhi (Madhya Pradesh) in search of relict elements of the last glacial period, (ii) south Malabar for Malayan elements of fauna; (iii) Sikkim in collaboration with the Bombay Natural History Society (BNHS) on the migration of high altitude birds, and (iv) Darjeeling for studies on a rare egg-eating snake. During this period, the Survey also participated in the London based newspaper, the *Daily Mail*'s Himalayan Expedition (1954) to Nepal in search of the Abominable Snowman, popularly called Yeti [which as is now known is the Himalayan brown bear — Eds].

During the second Five Year Plan (1956-57 to 1960-61), extensive field studies were carried out in the desert of Rajasthan and former French pockets in south India. Comprehensive surveys of the Andaman and Nicobar Islands and Gir forest were undertaken. Ecological studies on the shipworms of Sunderban were also carried out. Besides these, the Survey also participated in the Indian Cho Oyu Expedition (1958) to Nepal, the Harvard Yale Expedition (1958) to Sikkim and Darjeeling for birds, the Indo-German Expedition (1955-58) to different parts of the country for assessing the vertebrates, and the Indo-Swiss Entomological Expedition to northwest and northeast Himalaya. Special field studies on the population dynamics of desert locusts in India and termite fauna of the country were also carried out.

The third Five Year Plan (1961-66) saw a glorious period in the history of the Zoological Survey of India when major expansion in the organisation and fieldwork were done. Several new regional/field stations were created in order to cover various ecosystems of India. During this period, extensive studies were carried out at the construction site of the Nagarjunasagar Dam to record the ecological faunal succession on the completion of the dam. Besides this, several other important surveys were undertaken, which included: (i) Coastal Survey of Orissa, Andhra Pradesh, erstwhile Madras and the Gulf of Mannar for marine organisms, (ii) the Andaman and Nicobar Islands, (iii) the Western Ghats, and (iv) Rajasthan and Goa. Several scientists of the Survey also participated in Mahanadi estuary field studies, with particular reference to shipworms. Besides these, our scientists participated in the faunistic survey programmes of the International Indian Ocean Expedition (1962-64) on board *I.N.S. Kistna* and the Russian ship *Vityaz*. Other important studies conducted during the period include census of the spotted deer or chital (*Axis axis*) in Dehra Dun forest, Joint Exploration to Andaman sea, Andaman and Nicobar Islands and NEFA with the Defence Research and Development Organisation (DRDO). The Survey also participated in the Ross Expedition (1961-62) to different regions of India for the study of insects, and the Royal Ontario Museum Expedition to Anamalai Hills in Tamil Nadu for general faunistic collection.

During subsequent annual plans and the fourth Five Year Plan (1966-1974), the most noteworthy field surveys undertaken were to Bhutan for birds, Burzahom (Jammu and Kashmir) for animal remains of prehistoric times, Kerala coastal areas for wood borers, and the Andaman and Nicobar Islands for marine organisms. The scientists of the Survey also participated in Multidisciplinary Scientific Expeditions to Daphabum (1969-70) and Subansiri (1974-75) in Arunachal Pradesh, and the Rupkund and Tons Valley Expedition to Uttar Pradesh. Special emphasis was also given to the survey of national parks and sanctuaries, particularly Corbett National Park in Uttar Pradesh, Kanha National Park in Madhya Pradesh, Hazaribagh National Park in Bihar, and Kaziranga Wildlife Sanctuary in Assam. Further, the Garo Hills in Meghalaya, Narmada river valley in Madhya Pradesh, Western Ghats in Karnataka and Kodaikanal, and Palni Hills in Tamil Nadu were also surveyed for general wildlife fauna. The Peacock survey was taken up with National Sample Survey Organisation. A joint oceanic expedition on board *I.N.S. Darshak* of the Naval Hydrographic Department the Arabian sea during 1973-74 was conducted and data was collected on the sonic scattering layers, along with samples of zooplankton, nekton and benthos.

Scientists participated in the oceanic expedition with *R.V. Chota Investigator* for pollution studies at Madras (=Chennai); the BNHS and WWF Expedition to Ladakh (1976) for the status survey of the black-necked crane, bar-headed goose and several wild goats and sheep. ZSI personnel also participated in the Indo-Japanese Entomological Expedition (1978-79) to northwestern and southern India, and the multidisciplinary, inter-institutional expedition to Sikkim (1978-79).

Projects such as the impact assessment of bio-ecological changes in the faunal patterns brought about by partial submergence of Corbett National Park, eco-ethological studies and population estimates of the Cercopithecid primates of peninsular India, status survey of endangered and threatened species of animals and birds of Nanda Devi Sanctuary, population of rhesus macaque and hanuman langur of India, effect of pollution on some organisms in zooplankton, benthos and nekton contributing to the food chain in marine environment, etc. emphasising field zoology were undertaken.

Thereafter, new lines of research on ecology were undertaken, namely: nematode pests of crops and their control, bio-ecological studies on soil microarthropods, the biology, ecology and distribution of a land snail; ecological interaction of the Xylophagous insects of the Andaman and Nicobar Islands, population periodicity and ecology of the vector of Kala-azar in north Bihar; abundance and seasonal fluctuation of Phlebotomid sandflies in north Bihar. Other studies undertaken were: filth inhabiting flies of Calcutta (=Kolkata); prevention of fouling organisms in the cooling sea water system of the thermal plant at Tuticorin; Meiofauna of Sagar Islands; biological rhythms of the Indian false vampire *Megaderma lyra*; study of light-attracted insects; bioecological studies on *Macrosiphoniella sanborni*, a pest on Chrysanthemum; species composition, population fluctuations and ecological succession of thrips; population ecology of the most endangered species of mammals and birds in the arid zones of Rajasthan and Gujarat; parasitic Hymenoptera and other predatory insect resources of the northeast Himalaya; ecological and environmental impact of multipurpose river-valley projects, with particular reference to the Idukki Hydroelectric Project.

Impact of Field Zoology

Contributions from the field explorations conducted by various scientists resulted in special publications such as INDEX HORANA; SIPHONOPHORA FROM INDIAN OCEAN as well as ECTOPARASITES OF BATS OF RAJASTHAN. Other field

zoology publications include: Odonate distribution in western Himalaya, Taxonomic studies of earthworms collected during Subansiri Expediton of Arunachal Pradesh, Spider fauna of Calcutta and its vicinity with special reference to the revision of Indian crab-spiders. The ZSI also published Catalogues of oriental Dermaptera, Crustacea; Memoirs on Freshwater Sponges and Polyzoa; Catalogues of Stomatopoda, Passelid beetles. Publications on Francis Day and his collections of Indian fishes; Aphids of economic importance; Termite pests of agriculture, Taxonomic studies of some of the Indian non-mulberry silk moths; Taxonomy, ecology and biology of nematode associated with jute crops; Taxonomy of Chaetognatha; and a monograph of the tongue soles of the genus *Cyanoglossus* Hamilton were also brought out by the Survey. Special volumes on conservation issues include: Habitat suitability analysis of the Chinkara *Gazella bennettii* in Rajasthan — a remote sensing approach; Effects of heavy metal contaminated sewage effluents on the soil arthropods in and around Calcutta; Water Birds of North India; Fig insects of Kerala; Ecology of soil orbtid mites; Habits and habitats of Dragonflies of Northern India; etc. Several 'Wetland' and 'Fauna of India' series were other important contributions based on field studies.

However, the priorities of the Survey were defined in 1987, when the Ministry of Environment and Forests allotted a targeted programme for the following decade. The ZSI was asked to reorient its priorities under: (i) Fauna of States, (ii) Fauna of Conservation Areas, (iii) Fauna of Important Ecosystems, (iv) Status survey of endangered species, and (v) Ecological/Behavioral studies. In brief, the areas for study envisaged then were:

1. Himalayan Ecosystem (Western, Central and Eastern)
2. Desert Ecosystem (Gujarat, Rajasthan and Ladakh)
3. Tropical Rainforest Ecosysem
4. Marine Island Ecosystem
5. Fauna of States
6. Selected Estuarine and Brackish and Freshwater Ecosystems
7. Biosphere Reserves, Mangroves and Protected Areas

The Survey has carried out extensive surveys in the areas mentioned above. However, it was realised that the time frame allotted for such vast field studies was not sufficient and, therefore, the targets were revised so that greater emphasis could be given to field studies, particularly in the post-biodiversity convention scenario.

Current field programmes

Currently the Zoological Survey of India with its huge organisational setup consisting of its Headquarters at Kolkata and 16 regional/fields stations located in different parts of the country — Dehra Dun, Shillong, Jodhpur, Jabalpur, Chennai, Solan, Patna, Pune, Port Blair, Itanagar, Kozhikode, Hyderabad, Berhampur, and Canning and Digha in West Bengal —carry out regular surveys in the respective areas in order to achieve the assigned targets. Besides, the specialist scientists at headquarters carry out fieldwork related to their specialisation. Some of the recent field programmes of the Survey include: (i) Coral reef and coral associates in the Andaman and Nicobar Islands, Gulf of Mannar in Tamil Nadu, Gulf of Kutch in Gujarat and Lakshadweep, (ii) Habitat suitability and analysis based on the GIS, (iii) Re-survey of Chilka lagoon, (iv) Primate studies in northeast and southern India, (vi) Desert, marine, freshwater, mountain ecosystem studies (vii) Tropical Rainforest ecosystem studies, (viii) Status survey of Endangered species (ix) Studies on selected Protected Areas, and (x) Ecological studies on insects and mites of economic importance.

Field studies in relation to public service

A large number of field studies carried out by the scientists of the Zoological Survey of India

have a direct bearing on various aspects of public life, some of which are:

Biodiversity conservation: The faunistic exploratory studies conducted provide baseline data on the rich faunal diversity of the country, which is the basis for conservation of these bioresources.

Agriculture: Studies on economic values such as damage to agricultural crops by rats (with special reference to *Bandicota* sp. and *Rattus* sp.); bats and birds in eastern and northern India; damage to vegetable crops by mites; nematodes associated with paddy and citrus crops; orthopteran and hemipteran pests of crops and vegetables; stem borers and other harmful species.

Forestry: Studies on the ecological interaction of xylophagous insects (timber pests) of Andaman and Nicobar Islands, woodborers and defoliators of forests in West Bengal, damage by termite fauna in general.

Fisheries: The studies on the production ecology of ponds, reservoirs and lakes, biology of commercially important freshwater and marine fishes, studies on edible crabs, commercially important freshwater and marine fishes of India, all these leading to the improved fish catch and harvesting.

Public health: Studies on the biology and ecology of mosquitoes and sand flies in eastern and southern India, helminth parasites and their vectors, and haematozoan protozoa, in the interest of human health.

Environmental conservation: Causes and remedies of the water pollution of some lakes (urban lakes of Hyderabad and Kolkata), reservoirs, rivers (Ganga, Damodar, Hoogly-Matla) and coastal waters (Chennai coast), industrial soil pollution in Durgapur region and its monitoring by soil microarthropods, as a part of conservation studies.

Wildlife conservation: Ecological and behavioral studies on some avian species of northern India; Tibetan wild ass; wild ass of Rajasthan and Gujarat; macaques, langurs and hoolock gibbon, antelopes and deer of Rajasthan and Madhya Pradesh; lesser cats and giant squirrels of north Bengal; elephants of wildlife sanctuaries of Orissa, Bengal and Bihar; and status survey of some important endangered species, where many of them are keystone species or umbrella species.

Animals in relation to tribals: Detailed studies on the relationship between various tribals and animals in northern, eastern and central India and the Andaman and Nicobar Islands, pertaining to the utility of animals for food, medicine, fertiliser, fuel, dyes, pets, witchcraft, astrology, vectors, totems, taboos, myths, folklore and omens, besides the use of various animal products as ornaments and for decoration.

Specific role of the field studies by ZSI in biodiversity conservation and bioprospecting

The field studies carried out by ZSI are not only important for biodiversity conservation but they also provide valuable information for biotechnology and bioprospecting. Call it bioprospecting, chemical prospecting or gene hunting — a search for wild plant and animal products of potential value to medicine, agriculture, cosmetics and other uses has been going on for hundreds of years. Today bioprospectors gather and study the extracts of everything from spider venom to soil microbes to algae. However, biotechnology and bioprospecting should not be furthered at the cost of genetic and environmental diversity of animals. It is the prime duty of the ZSI to see that technological advances in the biological system do not hamper the natural distribution and abundance of animal species, and at the same time to document all animal species, which at some future time may be useful to mankind. This can only be achieved by collecting information on every species from the single celled protozoans to the largest mammals, the elephant on land and the blue whale in the ocean.